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### **A Macro Model for Bangladesh**

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**Micro Impacts of Macroeconomic and Adjustment  
Policies in Bangladesh Project**

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# **A Macro Model for Bangladesh**

## **1. Introduction**

The objective of the paper is to develop a small macroeconomic model for Bangladesh to capture the macroeconomic linkages in the economy. The nexus between output, government deficit, external sector, money supply and inflation are captured in the model. The model can be used to examine the effects of both domestic and external shocks on the economy. The model can also be used to analyze the effects of monetary, fiscal and exchange rate policies on the macroeconomy.

## **2. Specification of the model**

The model consists of Six blocks – production, expenditure balance of payments, government, monetary and prices block. It is recognized that in Bangladesh supply constraints have a major influence on the macroeconomy though in some areas demand side factors also exert important influence. There are 29 behavioural equations and 15 identities in the model.

### **2.1 Production Block**

In the production block three equations have been specified – one each for agriculture, manufacturing and services. The services sector includes all producing sectors except agriculture and manufacturing and is termed services for brevity. In each sector production depends on capital stock. In addition imported intermediate and raw materials act as constraint to production in agriculture and manufacturing and hence it is included as an explanatory variable in the production function. In a labour surplus economy labour does not act as a constraint to production. Hence labour is not included in the production function. Further, an index of rainfall is included in the agricultural production function to account for the effect on agricultural production. The production functions are specified as follows:

### **2.2 Value added in agriculture**

$$VAGR = \beta_0 + \beta_1 KAGR + \beta_2 MR + \beta_3 RAIN$$

### **2.3 Value added in manufacturing**

$$VMAN = \beta_4 + \beta_5 KMAN + \beta_6 MR$$

## 2.4 Value added in services

$$V_{SER} = \beta_7 + \beta_8 K_{SER}$$

## 2.5 Capital Stocks

In the absence of better measure for sector specific capital stock, capital stock is generated following perpetual inventory method:

$$K_{AGR} = (1 - \delta) K_{AGR}(-1) + I_{AGR}$$

$$K_{MAN} = (1 - \delta) K_{MAN}(-1) + I_{MAN}$$

$$K_{SER} = (1 - \delta) K_{SER}(-1) + I_{SER}$$

## 2.6 Investment

Investment demand is divided into private investment and public investment. Public investment is a policy variable. Private investment is classified by sectors. Interest rate is not an argument in the investment function. Availability of credit is a constraint to private investment. Besides, public investment does not crowd out private investment in developing countries like Bangladesh. Rather, it complements private investment. Real total public investment appears as an argument in the investment function instead of sectoral public investment as public investment has intersectoral effects. For example, investment in infrastructure create favourable impact on all types of private investment. Accordingly, sectoral investments are specified as functions of real sectoral credit and real public investment.

$$I_{AGR}_P = \beta_9 + \beta_{10} C_{AGR}_P + \beta_{11} GI$$

$$I_{MAN}_P = \beta_{12} + \beta_{13} C_{MAN}_P + \beta_{14} GI$$

$$I_{SER}_P = \beta_{15} + C_{SER}_P + \beta_{16} GI$$

## 3. Expenditure Block

The expenditure block consists of only one equation for private consumption. Government consumption is treated in the government block. Private consumption is specified as a function of disposable income and lagged consumption.

$$CON = \beta_{17} + \beta_{18} YD + \beta_{19} CON(-1)$$

Lagged consumption is included in the consumption function to account for lagged effect on consumption.

#### 4. Balance of Payments Block

The balance of payments block consists of ten equations – 6 equations determine the volume of exports and 4 equations determine the volume of imports. Exports of jute, jute manufactures, RMG and knitwear, frozen food, tea and leather are specified by corresponding export supply functions. It is assumed that Bangladesh is a price taker in the world market, Consequently the export prices are given by the world market prices. It is assumed that main constraint to export of Bangladesh arises from the supply side. Bangladesh an export whatever it can supply. Export supply is determined by export price relative to domestic price level as well as capacity output. Export supply of RMG and knitwear is also affected by quota available from the U.S.A. and Canada as well as GSP certificates from the EU. Utilization rate of quota is used as a proxy variable to account for these factors.

Import of foodgrains, raw materials and intermediate goods, capital goods and consumer goods are explained in the model. Foodgrains import is specified as a function of import price relative to domestic price of foodgrains and real foodaid. Imports of raw materials and intermediate goods is determined by import price relative to domestic price of raw materials and gross domestic product. Capital goods import is related to import price relative to domestic price of capital goods, real non food aid and aggregate investment in the economy. Investment demand in the economy create demand for capital goods imports. Finally, consumer goods demand for imports has standard specification -- import price relative to domestic price and gross domestic product being the explanatory variables. In the absence of suitable price variable wholesale price index is used as a proxy variable in the latter two cases.

##### 4.1 Exports

$$XJ = \beta_{20} + \beta_{21} \frac{PXJ.EXR}{WPI} + \beta_{22} XJC$$

$$XJM = \beta_{23} + \beta_{24} \frac{PXJM.EXR}{WPI} + \beta_{25} XJMC$$

$$XRMG = \beta_{26} + \beta_{27} \frac{PXRMG.EXR}{WPI} + \beta_{28} XRMGC + \beta_{29} QUOT$$

$$XFF = \beta_{30} + \beta_{31} \frac{PXFF.EXR}{WPI} + \beta_{32} XFFC$$

$$XT = \beta_{33} + \beta_{34} \frac{PXT.EXR}{WPI} + \beta_{35} XTC$$

$$XL = \beta_{36} + \beta_{37} \frac{PXL.EXR}{WPI} + \beta_{38} XLC$$

## 4.2 Imports

$$MF = \beta_{39} + \beta_{40} \frac{PMF.EXR}{PF} + \beta_{41} FAID$$

$$MR = \beta_{42} + \beta_{43} \frac{PMR.EXR}{WPIR} + \beta_{44} GDP$$

$$MK = \beta_{45} + \beta_{46} \frac{PMK.EXR}{WPI} + \beta_{47} NFAID + \beta_{48} INV$$

$$MC = \beta_{49} + \beta_{50} \frac{PMC.EXR}{WPI} + \beta_{51} GDP$$

## 5. Government Sector

### 5.1 Revenue

Government revenue originates from tax and non-tax sources. Because of substantial dependence of tax on imports, taxes are divided into import duties, other trade taxes and internal taxes. Import duties and trade taxes are related to imports. Internal taxes are specified as a function of nominal GDP and its own lagged value to reflect partial adjustment. Similarly, non-tax revenue is made a function of nominal GDP and its own lagged value to reflect partial adjustment.

$$REVM = \beta_{52} + \beta_{53} MV$$

$$REVT = \beta_{54} + \beta_{55} MV + \beta_{56} DUM$$

$$REVIN = \beta_{57} + \beta_{58} GDPV + \beta_{59} GREVIN(-1)$$

$$REVNT = \beta_{60} + \beta_{61} GDPV + \beta_{62} GREVNT(-1)$$

### 5.2 Expenditure

Government expenditure is divided into consumption expenditure and investment expenditure. Consumption expenditure includes both consumption expenditure and transfer payments. Expenditures are made to depend on nominal GDP and its lagged value. The lagged dependent variable reflects certain degree of irreversibility in consumption expenditure. A time trend is included to capture stronger role of the government in its traditional activities despite market oriented reforms. As mentioned before investment expenditure is regarded as a policy variable.

$$GCE = \beta_{63} + \beta_{64} GDPV + \beta_{65} GCE(-1) + \beta_{66} T$$

## 6. Monetary Block

### 6.1 The Supply of Money

The monetary system of Bangladesh consists of the Bangladesh Bank (the central bank) and the scheduled banks. They interact with the public and create money held by the public. The total money supply is specified as a function of private sector credit and government budget deficit.

$$M = \beta_{67} + \beta_{68} CREDP + \beta_{69} GBD$$

Interest rate is regulated by the government. There is also rigidity in the interest rate because of the oligopolistic structure of the banking system. The equilibrating mechanism in the monetary sector does not work through the demand for and supply of money determining the rate of interest. Rather, the change in money supply affects the price level. Accordingly, demand for money is not modeled in this exercise.

## 7. Price block

The GDP deflator is determined by money supply in the economy, real GDP import price index and lagged price level. The wholesale price index is determined by money supply and real GDP. The wholesale price of raw materials is explained by money supply and income in agricultural sector.

$$PGDP = \beta_{70} + \beta_{71} M + \beta_{72} GDP + \beta_{73} PM + \beta_{74} PGDP(-1)$$

$$WPI = \beta_{75} + \beta_{76} M + \beta_{77} GDP$$

$$WPIR = \beta_{78} + \beta_{79} M + \beta_{80} VAGR$$

### Linkages in the Model

The model captures different linkages as they exist in the economy.

- (i) Production affects consumption expenditure, imports and thus foreign exchange reserves, government revenue and government consumption expenditure. Finally, it affects the GDP deflator and the wholesale price index.
- (ii) Banking sector credit to the private sector affects sectoral investments which works through the capital stock to affect output.
- (iii) Money supply is affected by external sector and government sector which in turn affects GDP deflator, wholesale price index and wholesale price of raw materials.
- (iv) Prices are affected by both real sector and monetary sector variables, wholesale prices influence exporters choice of export and importers decision to import.
- (v) Public investment influences private investment which moves the economy through various linkages as mentioned earlier.

### Identities

$$\begin{aligned} CAD &= XV - MV + FKI + EO \\ CREDP &= (CAGR + CMAN + CSER) WPI \\ GBD &= TGE - TREV + RESB \\ GDP &= VAGR + VMAN + VSER \\ GDPV &= PGDP * GDP \\ GI &= IAGRg + IMANg + ISERg \\ IAGR &= IAGR_p + IAGR_g \\ IMAN &= IMAN_p + IMAN_g \\ INV &= IAGR + IMAN + ISER \\ ISER &= ISER_p + ISER_g \end{aligned}$$

$$\begin{aligned}
MV &= MF.PMF.EXR + MR.PMR.EXR + MK.PMK.EXR + MC.PMC.EXR + \\
&\quad RESM \\
TGE &= GCE + PGI.GI+ GEO \\
TREV &= REVM + REVT + REVIN + REVNT \\
XV &= XJ.PXJ.EXR + XJM.PXJM.EXR + XRMG.PXRMG.EXR + \\
&\quad XFF.PXFF.EXR + XT.PXT.EXR + XL.PXL.EXR + RESX \\
YD &= GDP + (REVM + NFI + NTR)/ PGDP
\end{aligned}$$

## **List of Variables**

### **Endogenous variables**

CAD	=	current account deficit
CON	=	private consumption
CREDP	=	nominal credit to the private sector
GBD	=	government budget deficit
GCE	=	government consumption expenditure
GDP	=	gross domestic product,
GDPV	=	nominal gross domestic product
GI	=	real government investment
IAGR	=	real investment in agriculture
IAGR <sub>p</sub>	=	real private investment in agriculture
IMAN	=	real investment in manufacturing
IMAN <sub>p</sub>	=	real private investment manufacturing
INV	=	real investment
ISER	=	real investment in services
ISER <sub>p</sub>	=	real private investment in services
KAGR	=	capital stock in agriculture
KMAN	=	capital stock in manufacturing
KSER	=	capital stock in services
M	=	money supply
MC	=	import of consumer goods
MF	=	import of food grains
MK	=	import of capital goods
MR	=	import of intermediates and raw materials



MV	=	value of imports
PGDP	=	GDP deflator
REVM	=	revenue from import duties
REVIN	=	revenue from internal taxes
REVNT	=	revenue from non-tax sources
REVT	=	revenue from other trade related taxes
TGE	=	total government expenditure
TREV	=	total government revenue
VAGR	=	value added in agriculture
VMAN	=	value added in manufacturing
VSER	=	value added in services
WPI	=	wholesale price index
WPIR	=	wholesale price index of raw materials
XFF	=	export of frozen food
XJ	=	export of jute
XJM	=	export of jute manufacturers
XL	=	export of leather
XRMG	=	export of readymade garments
XT	=	export of tea
XV	=	value of exports
YD	=	disposable income

### **Exogenous variables**

$\delta$	=	depreciation rate
CAGR <sub>p</sub>	=	real credit to agriculture
CMAN <sub>p</sub>	=	real credit to manufacturing
CSERP <sub>p</sub>	=	real credit to services
DUM	=	dummy variable which is introduced to account for introduction of VAT in 1991-92
EO	=	errors and omissions in balance of payment
EXR	=	exchange rate (taka per U.S. Dollar)
FAID	=	real food aid
FKI	=	foreign capital inflow

GEO	=	other expenditures which include food account surplus and non-ADP capital and net lending
IAGR <sub>g</sub>	=	real government investment in agriculture
IMAN <sub>g</sub>	=	real government investment in manufacturing
ISER <sub>g</sub>	=	real government investment in services
NFAID	=	real non-food aid
NFI	=	net factor income from abroad
NTR	=	net transfers from abroad
PGI	=	price index for public investment
PM	=	price imports.
PMC	=	import price of consumer goods
PMF	=	import price of food grains
PMK	=	import price of capital goods
PMR	=	import price of intermediate goods and raw materials
PXFF	=	export price of frozen food
PXJ	=	export price of jute
PXJM	=	export price of jute manufacturers
PXL	=	export price of leather
PXRMG	=	export price of RMG
PXT	=	export price of tea
RAIN	=	rainfall index
RESB	=	residual in the budget balance
RESIM	=	residual in current account payments
RESX	=	residual in current account receipts
T	=	time trend
XJMC	=	rate of capacity utilization in jute manufacturing sector
XLC	=	capacity utilization rate in leather sector
XRMGC	=	capacity utilization rate in RMG sector
XTC	=	capacity utilization in tea sector